Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

VOL. XI. No. 24. NOVEMBER 19, 1914

THE JOURNAL OF PHILOSOPHY
PSYCHOLOGY AND SCIENTIFIC METHODS

THE PULSE OF LIFE

ON various occasions[1] I have expressed the opinion that life and mind must be defined in terms of behavior whether observed or expected. The reasons that led me to this conclusion have been set forth at sufficient length,—they all come back to this one: that to assert the existence or non-existence of any thing is meaningless unless we can verify the assertion, but experience is the only means of verifying assertions, and behavior the only aspect of the beings we call living or conscious which is matter of experience. Hence in our empirical reasons for calling one thing alive, another not, one thing conscious, another unconscious, must lie the meaning of life and mind.

I had not thought to return to this matter whose interest for me lay rather in what it led up to[3] than in its own modest content. But I have come to see that one can not define a method without illustrating it, unless one is willing to be widely misunderstood. I have had sufficient occasion to realize this, for the thesis which seemed to me so much a matter of course has been regarded by many as revolutionary,[3] not to say "*waghalsig,*"[4] and a way of looking at things which I should have called Aristotelian has been interpreted as "materialistic."[5]

The fault, of course, is my own. I have confined myself to showing why life and mind *must* be defined by a certain method, and have offered no reply to those who ask,—But how can they be? I have pointed to behavior as that in terms of which life and mind must be set forth, but I have not answered the question,—What behavior? One might well enough remind me that "*Kein tolleres Versehen kann sein, Gebt Einem ein Fest und läd ihn nicht ein.*"

To mend all this there is but one way, and that is to sketch in a picture of the world as it appears to one who has come to look upon life and mind as behavior. Such a picture can not be presented with any confidence that its details are correctly drawn; as one hand moves the pencil the other is ready with the eraser. But as an illustration of method the whole imperfect thing has its interest, and while in my impatience to get on to the consequences of a theory I faced the task of illustrating it as an unwelcome interruption, I have nevertheless experienced in the working out no little enjoyment.

---

[1] This JOURNAL, Vol. VIII., page 180; Vol. IX., page 15 and page 206.

[2] *Ibid.*, "Man and Fellow Man," Vol. X., page 141.

[3] Miller, *ibid.*, Vol. VIII., page 322.

[4] Jacoby, *Internationale Monatsschrift.* Jg. 8, No. 1, page 7.

[5] Montague, "The New Realism," page 271.

But in this first paper I shall attempt no more than a picture in which *life* appears—the concept of *mind* shall be for another time.

LIFE AND MECHANISM

As the medium in which the image of life is to be wrought, let me assume the world of mechanism. When I conceive such a world, I spread it out in space and attach to each of its points a limited number of characteristics or parameters which I then connect by such formulas as enable me to express their values as functions of a single variable, *time*. To construct such an image of the world we live in is the ideal of physical science. It is only an ideal, and to have chosen it as a medium in which to work means no more than to have registered a pious intent to introduce no definition of life or mind which shall stop our approach to the mechanical ideal. Those whom the history of physical science inspires with no such respect for its ideal as to require them to conform their notions of life to it will care little for an image worked out in a medium they reject. Their quarrel with me is serious enough; but this is not the moment to enter on it nor a suitable *terrain*. It can be only for such as regard the mechanical ideal as inviolable that the problem of defining life consistently with it is a real problem.

But for such the problem is very real, for every one knows how difficult it is to pass from an image of the world as mechanism to an understanding of that same world as the medium not only in which, but also of which life has its being. The difficulty which this transition offers to thought has sometimes been taken for a very hiatus in the order of nature, a chasm and an abyss so threatening to the continuity—not to say the consistency—of our thought that the most extraordinary philosophies have been built to bridge it. The most notorious of these inventions are (1) that which attempts to make life consistent with mechanism by making life mechanical, (2) that which tries to make mechanism consistent with life by making mechanism alive at every point. The first, I think,[6] may fairly be

[6] I say "I think," for since I find that I have myself been called a "panhylist," which must be an aggravated variety of materialist, I am not sure that I know what idea, if any, the term materialist conveys. If every one is a ma-

called a *materialistic,* the second a *monadistic* account of the relation of life to mechanism.

For one who confines himself to determining what behavior on the part of certain objects of our experience makes us call them living, and who then defines life as that which is common to the behavior of living things, neither materialism nor monadism is possible; but neither for such an one does the gap exist for whose bridging these philosophies have been invented. He makes it his problem so to define life that it may dwell in mechanism and be of it, but in such manner that neither shall life be turned into mechanism nor mechanism into life.

MATERIALISM

In framing such a definition of life we shall be in accord with very old tradition if we consider that a certain purpose is revealed in the behavior of the beings we call living, and that it is because of this purposive behavior we call them so. But to erect this purpose into a definition of life is to enter at once on the troubled domain of teleological definition.

The confusion that usually attends upon this method of defining comes, I think, from our failure to keep distinct the two classes into which a single individual may fall when one of these classes is defined without reference to purpose; the other connotes nothing but a sameness of purpose. The distinction is obvious enough when our thought is not troubled by the application of both methods of classifying to the same system. The classes "triangle," "gravitational system," "salt" suggest nothing of a common purpose served by triangles, or by gravitational systems, or by salts. A triangle *must be* three-sided and plane, it *may be* the best form for a spear-head, for an element of a bridge truss, for a certain fashion of musical instrument. Neither is any one purpose served by gravitational systems, nor have salts a unique function. The definition of these geometrical, physical, and chemical concepts is ateleological and the sciences dealing with terms so defined might be called *ateleological* sciences. On the other hand, the classes "musical instrument," "time-piece," "seasoning," connote nothing of the geometry, physics, or chemistry of the objects contained in them. A musical instrument *must be* capable of producing pleasant tones, it *may have* the structure of a triangle, or of a fiddle, or of a flute. So "time-pieces" may vary in mechanism from a sun-dial to a chronoscope, and to make its proper appeal the

terialist who refuses to look upon the contours of a living being as the boundary of a region in which the kind of predictability that holds outside of it breaks down, then I am a materialist along with Spinoza and Kant. If, on the other hand, a materialist is one who attempts to give a mechanical definition of life, then, unlike Democritus, or Lamettrie, I am no materialist.

"seasoning" may call for salt or it may call for pepper. If, then, there is any group of sciences whose peculiar and specific concepts are defined in terms of purpose and place no limit on the variety of mechanisms which may be found to serve this purpose, we might call such sciences *teleological.* It is in this group we should place biology, if that life of which biology is the study is properly defined in terms of purpose alone.

No one would be tempted to confuse these two *principia divisionis* if it were not for the puzzling way in which the classes they denote intersect and overlap. For example, that portion of the extended world which is at this moment bounded by the surface of my body is part of the universal mechanism, and is more or less like other parts in its mechanical structure. Hence it belongs to a class of mechanisms, ateleologically defined. Am I not, then, a machine? On the other hand, the history of my body's behavior reveals a purpose running through its various acts, a purpose quite like that which characterizes my neighbor, my dog, the moth that flutters by me. Am I not then a being with a purpose? And one may repeat this question apropos of every member of the class "living-being": it is a member of that class because its behavior reveals purpose; it has at each moment membership in another class defined without reference to purpose. Which is it, *really,* a thing of purpose or a mechanism?

But the question answers itself and I introduce it merely to point out the part it plays in the psychology of materialism. For materialism is nothing but an attempt to define life in terms of mechanism. It observes correctly enough that each living thing has at each moment a place in a class of mechanisms: it fails to observe how endlessly unlike these classes may be and seeks to state what is common to them as the definition of life. But there is nothing in the way of mechanism common to all that is or might be called living, and the living would never be put into a single class were they not moments in a scheme of purpose: the class living-being has nothing but a certain purpose common to its members and only this purpose can be offered as the definition of life. It is for this reason that as living I am classed with the grass of the field: as mechanism I am much more like my own corpse.

MONADISM

If the definition of life as a certain kind of purposeful behavior makes materialism impossible, it makes "monadism" or "hylozoism" no less so. For implicit in the concept of purpose is that of freedom, and freedom is exactly that which we have denied to the points of our mechanical system. At the point there can be no freedom, no purpose, no life.

That freedom is implicit in our definition of life may be made to appear by either of two comparisons. If we follow the history of any individual living thing we observe through what varying mechanical vicissitudes (of light, heat, chemism) it works out its purpose. "adapting itself" as we say to a wider or narrower range of circumstance. Or if we compare, not the same individual at different moments, but the most resemblant individuals at the same moment, we may measure their adaptability in terms of the range of mechanical situations that leaves their purpose as living beings undefeated. But to accomplish the same defining purpose in a variety of mechanical situations is to be independent of mechanism to a degree measured by the range of things that "do not matter."

The invariance of purpose in a variety of mechanical situations is freedom. We do not first find life and then speculate as to the freedom of living beings; it is not until we have found this freedom that we are sure of having found life.[7]

It is clear then that in a system whose points are assumed to be mechanically connected we can not posit life in all its freedom at the point. The only remaining possibility is to regard life as a phenomenon of the *group of points.* But how are we to effect a grouping of mechanically determined points so that the group shall be free when the points are not? How can a kind of grouping introduce freedom into a system whose elements are not free?

THEORY OF THE "PULSE"

The relation of whole to part is no one relation, but presents an infinite variety. The simplest type is that in which the whole is said to be equal to the sum of its parts, and because of the ease and familiarity of the operation of adding we are only too willing to think of all grouping as summation and to apply to it the principles of arithmetic. As a matter of fact the examples which our experience offers us of what might be called additive groups are rare: we think of a foot as the sum of the inches which compose it, of a pound as the sum of the ounces contained in it; but we should not get very far if we tried to think of a chemical molecule as the sum of its atoms, and we should go much too far if we insisted upon defining a state as the sum of its citizens. At the outset, then, it is well to protect oneself against a natural tendency to apply axioms of addition to all forms of composition. Can it be less absurd to say, The whole being equal to the sum of its parts, if there is no freedom in the part there can be none in the whole, than to say, A triangle being composed of straight lines, if there is no triangularity about each of these lines there can be none in their combination?

---

[7] Curiously enough the attention of those who discuss "freedom" has been centered on the possibility of doing different things under the same circumstances. This is not freedom, but caprice. Our freedom is measured by our ability to do the same thing under different circumstances: it is that *independence of circumstance* which Stoic and Epicurean understood so well.

Now of all the ways of composing a whole out of parts there is none which holds more surprises in store for the arithmetical soul than that which permits us to regard a wave moving through a medium as made up of the parts of that medium itself; for in no other form of composition is the non-additive character of the grouping more obvious, in none other is the contradiction between the properties of the group and the properties of the elements grouped more keenly felt. Through a medium whose parts are moving up and down, a pulse composed of these very parts may move horizontally; through a medium whose parts are moving back and forth about a center of equilibrium, a pulse may pass on and on. If we have overcome the primitive instinct to add, if the peculiarities of wave-composition no longer surprise us, there can be nothing to shock us in the further suggestion that through a medium of mechanism all of whose points are determined, a pulse of life may pass freely on its way.

Following this suggestion our method of defining life, though it insists upon the distinction between mechanism and life, denies the chasm between them. For imagine that through the infinite sea of mechanism already defined, there move certain wave-like forms, not indeed wind-tossed, but rather purpose-drawn; and imagine the purpose in terms of which the behavior of these forms could be explained and predicted to be that of *self-preservation;* would not each of these pulses correspond in all respects to what we call a living thing? Is it not as such a pulse that each thing which lives moves slowly on through the vast sea of mechanism drawn this way and that, not as the waves of the ocean are blown, but as "the lover is moved by the loved object"—until breaking upon some sudden obstacle or dying out in the viscous medium it is seen no more? But between such a pulse of life and the universal mechanism in which it arises, through which it purposefully moves awhile and into which it passes away again, there is no discontinuity or break. A new thing has indeed appeared, a new thing that is not to be defined or studied by the methods of mechanics: this new thing is a *group;* a group which is in the nature of a *pulse;* a pulse whose behavior may be defined in terms of *purpose;* a purpose which we recognize to be that of *self-preservation* requiring adjustment and adaptation to the various mechanical situations through which in the course of its history the pulse freely passes. This new thing is *life.*

THE SCIENCE OF LIFE

But if life can not be mechanically defined, if living behavior can not be mechanically explained or predicted, in what sense can there be a science of life? What must be the nature of the laws of such a science and on what sort of calculations can it enter?

The answer to these questions must depend upon our understanding of the term "purpose," which has entered into our definition of life and so must control our treatment of living phenomena. I take it that the accomplished purpose of an act will always be sought among the results of that act. No doubt the chick yonder embodies the purpose for which a certain egg was laid: it is also a result of that laying. But if we were to follow all the results of that laying, a humble barnyard episode would turn into a cosmic event on our hands. For that egg in falling has jarred the universe, and one wonders why out of its endless consequences just this unimpressive chick should have been taken as the one for whose sake the event befell. What is it that distinguishes the result that is a purpose from the infinity of other consequences that are merely accidental?

I know that it is usual to define purpose as the *desired* result and to accommodate this definition as best one may to the purposeful acts of the humbler order of beings; to the tree whose blossoming must express some one's or some thing's desire for another tree of the same kind, to the unicellular organism whose ingesting of a foreign body must betray its hunger. But in order that the concept of desire may have so wide an extension, must we not have made its meaning identical with that of purpose? Must we not have offered a tautology in place of a definition? Or else we may have done worse than this. We may have made of desire some immediate experience of which we believe ourselves in possession, but of which we can give no account or description; we may then have trusted to luck in assuming that others would understand us when we used this term; we may finally have appealed to analogy to justify the hypothesis that all things acting purposefully have a like subjective experience. The emptiness of each phrase that sets forth the process by which I am supposed to read my own inarticulate experiences into others has been sufficiently insisted upon elsewhere.[8] It will be enough to point out at this time that no one could verify the "hypothesis" of desire in fellow-man, fowl, shrub, or amoeba. How then could one make use of these unknown desires to distinguish the known purpose of an act from its accidental results?

No, the definition of purpose can gain nothing by an appeal to desire as that which can be established first in the study of any given act and then used to distinguish the purpose of that act from its accidental consequences. Such an appeal does indeed suggest that the distinction between the purpose and the accidental results of a given act requires us to collect other data than those furnished by the mechanical description of that act and its consequences. But these data can only be collected if they are as observable as the act itself. And what can be as observable as the act except *another* act that is like it? Here then we have our suggestion. If but once in the known history of the universe an egg were laid, a blossom burst, a morsel were ingested, would there be any possibility of our recognizing among the consequences of each unique event one that was its purpose? Or if the same sort of event happened many times, but among the consequences none were found to be common to the various cases, would we then be able to recognize a purpose in that type of event? But if, on the other hand, the type of event happened frequently enough to enable us to compare the spheres of consequence that emanated from each case as from an origin, and if we found that in a certain proportion of cases the same kind of result followed, would we not be justified in looking upon this *average common result* as *the purpose of the act,* assigning the remaining variable consequences to accident?

---

[8] This JOURNAL, Vol. VIII., page 180.

Purpose then may be defined as the average common result of a type of act. As an average result it is not expected to follow "always" but only as Aristotle would say "for the most part." Or rather, this classic expression is still too vigorous. For we recognize a result as a purpose when it is common to but a very small percentage of the cases falling within the type of act whose purpose it is. The purpose of the depositing of each shad's egg is no doubt the production of another shad, but it would be unfortunate for the rest of us if this result followed for the most part on the event. In place of the loose Aristotelian phrase we should substitute an exact mathematical expression, one that is based on an empirical study of statistics and presents itself finally as a *measured probability.* We may say then that the purpose of an event is the result which that type of event is *calculated* to accomplish; the calculus in question having for its data statistics and for its method the theory of probabilities.

A teleological science has for its laws the statistical principles which we call rules, but to contrast it for this reason with the "exact" sciences is inexact. For though from the very nature of the concepts which it employs a teleological science must deal with principles that apply to the individuals of a group *collectively,* and not *distributively,* there is no limit to the exactness with which these laws can be expressed. If we are interested in applying its results to an individual of a group it has studied, it can only offer us material for a calculus of what this individual will probably do, but it can give to this probability as exact an expression as it chooses.

There is then a science of life; it is an exact science of the probable in the domain of self-preservative behavior.

"SELF-PRESERVATION" DEFINED

It requires, I suppose, no special defense that we have taken only one of the purposes revealed in the behavior of living beings as the *defining* purpose. Any self-preservative being may belong to a number of other teleological classes—the type-preservative for example. In general the possession of one "nature" by a given individual does not exclude the possession of a different and even contradictory nature, for from what has already been said respecting the meaning of teleological classification, it will appear that the behavior which justifies us in assigning an individual to a given class may be and generally is only part of its total behavior. It will not surprise us then if self-preservative beings are also type-preservative and if at moments their type-preservative acts are self-destructive. In framing our definition we have included in it only the minimal connotation that would give to the class defined the denotation which has been traditionally accorded to the term life and which we are prepared to preserve for future use. It is sufficient for us that no finite being devoid of self-preservative behavior has been called living, and that we are prepared to recognize as living a being, however constructed, however devoid of other purposes or natures, if only it reveal self-preservative behavior.

But is this concept of self-preservation itself so clear and well defined that it may profitably serve for the defining of other terms?—I confess that I am not of those who move with ease and enjoyment through the domain of the reflexive categories. Even this most familiar one of self-preservation gives me pause. To preserve one's fortune, to preserve one's reputation, these expressions are intelligible enough because the preserver and the thing preserved are sufficiently marked off the one from the other to permit of a relation being set up between them. But when the preserver and the preserved are as closely identified as one is with oneself, it is with no gaiety of heart that I approach the task of so mixing "the same" with "the other" as to constitute the concept of self-preservation.

However, there comes to my mind the couplet into which a certain weary soul put the whole story of his life as it appeared to him in retrospect. "I ate," he said,

"I ate, drank, slept, and then,
I ate, drank, and slept again."

Now whatever of the richness and variety that sometimes pertain to the lives of men this unimpressed person had managed to miss or to forget, he had not been able to leave untold a certain minimum which is the content of life itself. And this minimum seemed to him to consist in a precarious sort of *againness* whose monotonous rhythm had filled his years. If one had asked him why he had thus eaten, he would have said, I fancy, in order that he might eat *again.* In the same sense that the fowl lays an egg in order to produce another fowl, our hero ate his dinner in order that he might eat another dinner. A being who so acts that the repetition of his act is well calculated to result from it, whose act is seen to be a means of ensuring its recurrence, is a self-preservative being.

Such, at least, is the simplest life definable; but our hero's was relatively complex: he not only ate, but he also drank and slept. We should doubtless be too additive in our methods if we represented him as doing each of these things for the purpose of doing just that thing again. Did he not do each in order that he might do all three again? A in order that he might do A, B, C . . . in the future, B, for the same reason, and C, with a like motive . . . ? A being whose acts may be analyzed into n types such that each type has for its purpose the repetition of all n types is not only a living being, but also an organism. I dare say we can find no example of a living being which is not also an organism, so that the terms living being and organism have come to be used interchangeably, but the meaning of organism contains more than the definition of life.

Thus we have our concept of organized self-preservation. The sameness implied in it is the sameness of the wave as a whole, the otherness the rhythm of its complex and changing contour as it is transmitted by and translated through the medium in which and of which it is.

CONCERNING DEATH

With this definition of self-preservative behavior, the picture of life and its relation to mechanism are complete. Yet it may be a matter of surprise to some that we have included in our definition of life no reference to the episode of death, so universal as to be commonly regarded as a part of life itself. Even Professor Schaffer, who startled an over-excitable if not over-imaginative world by accepting the possibility of a laboratory creation of life, was unable to stretch his thought to the point of conceiving a laboratory prevention of death.[10] But if one has gone so far as to exclude from one's conception of living things all reference to their way of coming into being, it would seem natural that one should include in one's definition no reference to their manner of passing away again. The *pos-*

[10] *Science,* N. S., 36, 289.

sibility of creating life and the *possibility* of eliminating death mean no more than that we may define life without reference to its beginning or end. Whether we can find or produce beings that fall within this definition and *also* meet certain conditions of beginning and ending is a purely empirical question, the ground of whose answering lies quite outside of the definition.

Birth and death then are only synthetically attached to life, but while the motive for reading birth into the definition of life is no deeper than an habitual association of ideas, I am not sure that the insistence on death as a thing whose germ lies in birth is to be explained in the same way. For we have seen that the teleological method of defining which gives us our concept of life is essentially statistical and looks upon the future of each thing in a class as a matter of probability. In order that there should be nothing more than probability, there must be a possibility that the future expected should not arrive: there must then be cases in which it does not. But the defeat of the purpose of the living being is death, and so its occurrence would seem to be essential to the meaning of life. It will be remarked, however, that this necessity of death is but a requirement that some die, not that all die. Death is an essential phenomenon of a group taken collectively, not of that group taken distributively. As for any individual, it is enough that for him life is not certain, nothing requires us to maintain that death is.

So I have defined life without reference to its beginning or its end; I have also defined it without reference to its higher and lower forms. It is possible to do this because so far as life goes the existence of the higher form is not involved in the meaning of the lower, and conversely. Where, however, these differences of higher and lower life exist it is possible to introduce a new category to describe their relations. This new category is *mind.*

EDGAR A. SINGER, JR.

UNIVERSITY OF PENNSYLVANIA.

A DEFINITION OF CAUSATION: A REPLY TO PROFESSOR SHELDON

PROFESSOR SHELDON, in an interesting series of four articles recently contributed to this JOURNAL,[1] draws attention to a new definition of causation. His results may be summarized as threefold:[2] (1) that two types of causation clearly emerge, "a certain serial type called a self-repeater, and one of composition"; (2) that "the

---

[1] Volume XI., pages 197, 253, 309, 365.

[2] Vol. XI., page 365.